

AN INTERAGENCY RESPONSE TO ASSESS ENVIRONMENTAL IMPACTS OF HURRICANE KATRINA



The U.S. Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), the Food and Drug Administration (FDA), and the U.S. Geological Survey (USGS) are coordinating an environmental impact assessment of Hurricanes Katrina and Rita in coastal waters throughout the affected region. By integrating response activities conducted aboard the EPA's OSV Bold, NOAA's R/V Nancy Foster, FDA small boat teams and numerous field activities in the shallow nearshore and wetland environments, this effort will characterize the magnitude and extent of coastal contamination and ecological effects resulting from this unprecedented storm. Efforts are currently underway to assess coastal ecosystems, biological condition, fisheries, water quality, sediment quality, seafood safety, and human-health risks in coastal ecosystems of Louisiana, Mississippi, and Alabama. This document provides a brief description of the various components of this comprehensive, coordinated, interagency effort.

1) Assessment of the Effects of Hurricane Katrina on Coastal Ecosystems – OSV Bold

Objectives: a) Assess the ecological condition and trends in condition of coastal Louisiana, Mississippi, and Alabama associated with Hurricane Katrina and its aftermath; and b) support local, state, and national efforts to assess aquatic resources, identify the stressors that cause harm or deterioration of these resources, document changes (e.g., improvements) over time, restore ecological condition, and protect human health.

Summary: EPA, NOAA, and U.S. Geological Survey (USGS) will collaborate in this interagency effort made possible through two existing EPA programs – National Coastal Assessment (NCA) [<http://www.epa.gov/emap/nca/index.html>] and Gulf of Mexico Hypoxia Monitoring and Modeling Programs. The scientific approaches, tools, data management and communication systems, environmental data, and partnerships established in these programs provide a sound and proven scientific basis for implementing a regional assessment of ecological conditions in northern Gulf of Mexico coastal waters impacted by Hurricane Katrina. These programs, coupled with NOAA's National Status and Trends Program (see activity 3 below), also have generated a wealth of base-line, pre-Katrina environmental data that can be compared with post-Katrina data to determine hurricane-associated impacts (Figure 1).

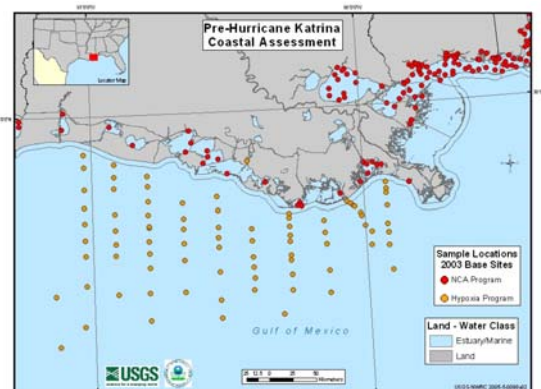


Figure 1

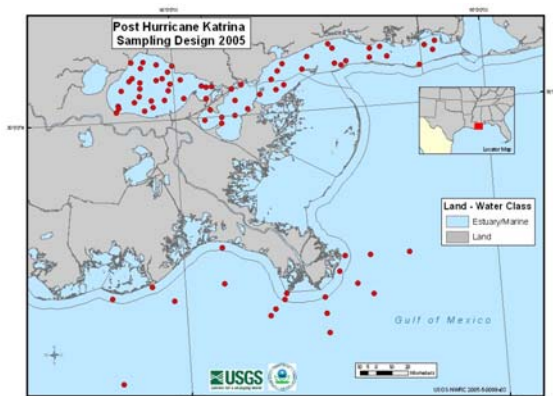


Figure 2

A probability-based survey design will be used to locate 60 random sampling stations (Figure 2) within Lake Pontchartrain (30 sites, to be sampled by USGS) and the coastal waters from Dauphin Island, AL to the western side of Lake Borgne, LA (30 sites, to be sampled by EPA and NOAA). A suite of NCA ecological indicators of sediment quality, water quality, and benthic condition will be collected and analyzed at each of these sites. Water and sediment samples also will be collected and analyzed for various microbial indicators and newly emerging contaminants of concern (see below). An initial, post-Katrina survey of all NCA indicators will be collected in the first two weeks in October, 2005 to assess the condition of coastal waters following Hurricane Katrina's impact. This effort will be repeated at least quarterly to document short-term changes caused by movement and dispersion of contaminants from Lake Pontchartrain into the coastal waters of Louisiana, Mississippi, and Alabama. An additional 19 stations (Figure 2) will be sampled around the Mississippi River Delta and near-shore river plume waters to characterize effects in

the Mississippi River outflow. These stations will be sampled in late September/early October in conjunction with quarterly Gulf hypoxia surveys, and quarterly intervals thereafter, using the suite of NCA ecological indicators of sediment and water quality and benthic condition, as well as indicators of fecal contamination. The OSV Bold will serve as the principal platform for sample collection and analysis.

Sediment samples will be collected at the randomly positioned NCA sites for analysis of chemical contaminants (DDT and other conventional chlorinated pesticides, PCBs, PAHs, metals), microbial/pathogenic indicators (*Clostridium perfringens*), grain size and organic carbon content (TOC), condition of resident benthic fauna, and sediment toxicity (Microtox and P450 Reporter Gene bioassays) as measures of contaminant exposure and biological effect. Water samples will be collected and analyzed for standard hydrographic parameters (DO, salinity, temperature, pH, depth, turbidity), microbial/pathogenic indicators (*Enterococcus*, fecal coliforms, and viral indicators), nutrients (total N & P, dissolved nitrate, nitrite, orthophosphate, and ammonium), chlorophyll a, total suspended solids, dissolved organic carbon, and chemical contaminants (conventional organochlorine pesticides, PAHs, oil and grease, metals). Additional contaminants of concern will be analyzed, including atrazine in water, flame retardants (e.g., PBDEs) in sediments, and Fipronil in sediments, as their potential human-health and ecological impacts have only recently become apparent in coastal and marine environments.

The USGS, who will be sampling the above 30 random stations within Lake Pontchartrain, will collect additional samples at 12 targeted sites along the southern shore of Lake Pontchartrain. Measures of chemical contamination, organic loading (nutrients, organic matter, chlorophyll), and abundance and distribution of coliform bacteria and other human pathogens will be obtained at each of the stations. Benthic community analyses and sediment toxicity tests will be performed as well to evaluate the degree to which contaminant burdens and organic loading resulting from this storm have impacted biological resources. EPA Region 4 and Mississippi DEQ will assess Hurricane Katrina impacts in coastal areas using complementary approaches and ecological indicators described above. This effort will estimate conventional and toxic pollutant loadings entering the Mississippi Sound from Bayou Casotte, Pascagoula/West Pascagoula River systems, Back Bay of Biloxi, St. Louis Bay, and the Pearl River during the time of the study.

This comprehensive and coordinated interagency effort will provide a scientifically sound assessment of initial human-health risks and environmental impacts of Hurricane Katrina in the affected waters and a record of how these conditions are changing with time. Quality assured data and scientifically sound assessments will be provided to local, state, regional and federal decision-makers to support environmental and public-health decisions, recovery, and restoration efforts.

2) Joint NOAA Cruises and Related Sampling – OAR, NMFS, and NOS Response Aboard the RV Nancy Foster

Objectives: a) Gather oceanographic data on plumes from the Mississippi and emanating from Lake Pontchartrain, b) collect fish tissues for contaminant analyses, c) collect sediments for contaminant analysis, d) survey for stranded marine mammals and reptiles, e) collect water chemistry to assess potential for harmful algal blooms (HABs).

Summary: The NOAA Office of Atmospheric Research (OAR) Atlantic Oceanographic and Meteorological Laboratory (AOML) conducted a joint NOAA cruise from September 13-16 with scientists from NOAA's National Marine Fisheries Service (NMFS) to collect water samples, sediment samples, and biological samples to assess the safety of fish and shellfish exposed to the potentially toxic post-Katrina flood waters in the Gulf of Mexico. The team of 10 scientists collected shrimp, blue crab, and Atlantic croaker — common ground fish — and has sent them to the NMFS laboratory in Seattle to be tested for bacterial and chemical contamination. NOAA/NOS's National Centers for Coastal Ocean Science (NCCOS) will provide additional support for the analysis of sediment-associated contaminants. An additional cruise on the R/V Nancy Foster is scheduled to commence on September 28, and run through October 4, to re-sample many of these same sites, as well as to collect samples from other areas of the Gulf of Mexico. For

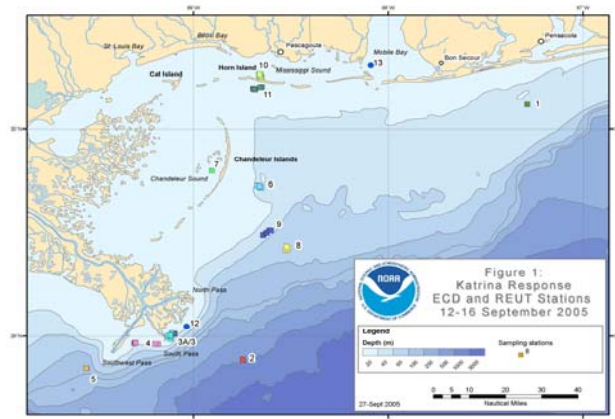


Figure 3

a

both of these cruises, the primary goals are to characterize the fate and composition of the runoff from the hurricane events, and to collect samples to assess the risk to seafood safety.

The cruise plan initially called for sampling at the mouth of the Mississippi River and stations inside and outside of Chandeleur Sound and Mississippi Sound (Figure 3). NOAA/OAR/AOML is currently analyzing the oceanographic, nutrient, suspended sediment load, and dissolved oxygen data resulting from the first cruise. Combined with data resulting from the joint EPA/NOAA/USGS surveys aboard the OSV Bold, this effort represents a significant contribution to the broader characterization of environmental contamination and its impacts in the region.

3) NOAA National Status and Trends Program (NS&T) Mussel Watch Project Contaminant Monitoring

Objectives: a) Measure contaminant burdens in the tissues of oysters in the affected region; b) measure contaminant concentrations in the substrate and waters surrounding oyster beds; c) measure known human pathogen indicators in coastal waters surrounding oyster beds; d) assist the US Food and Drug Administration (FDA) with the collection of oysters at NS&T/Mussel Watch sites for the analysis of additional chemical and microbial indicators of seafood safety; and e) perform P450 and Microtox bioassays to assess biological effects of contaminant exposure in sediments.

Summary: NOAA's NS&T Program supports ecosystem-based management through an integrated program of environmental monitoring, assessment, and research to describe the current status of pollution and to detect changes in the environmental quality of our nation's estuarine and coastal waters. These interrelated activities are designed to provide national context to measures of local and regional environmental condition

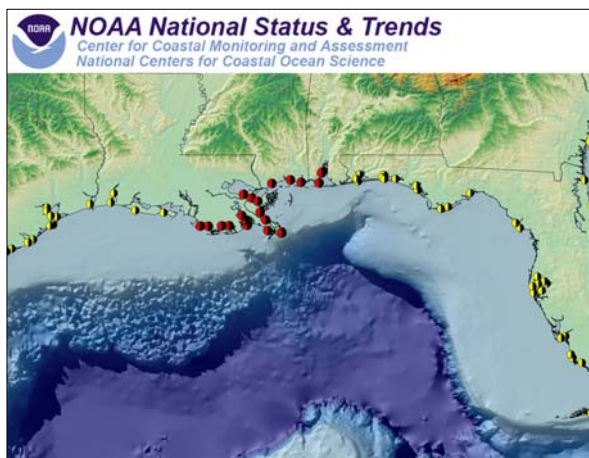


Figure 4

(<http://ccma.nos.noaa.gov/cit/data/welcome.html>). Mussel Watch principals have developed and are currently implementing a response strategy to assess the environmental impacts of Hurricane Katrina as expressed through sediment contamination concentrations and contaminant body burdens measured in the tissues of the American oyster (*Crassostrea virginica*). The NS&T Mussel Watch Project has a 20-year time series for over 120 contaminants in mussels from over 300 sites nationwide, including the sites shown in Figure 4. This extended time series provides a critical long-term baseline for contaminant levels in the affected region. Coupled with the broad spatial coverage provided by the NS&T monitoring efforts, scientists will have the quantitative information required to assess whether contaminant signatures from Katrina are significantly different from historic levels, and from neighboring regions. While these sites are generally monitored during the winter months, NS&T has moved up its sampling schedule to begin during the last week of September in the Katrina impact zone. A total of 20 Mussel Watch sites will be sampled during this response effort (figure 4, red sites). The standard Winter sampling effort also will be performed, thereby providing an assessment 4 to 5 months post impact.

At each of the locations pictured above (in red), Mussel Watch scientists will collect sediment and oyster tissue samples that will then be analyzed for a standard suite of NS&T Program analytes, including conventional pesticides, metals, PAHs, and PCBs. Toxicity tests (Microtox and P450 assays) also will be conducted on the sediment samples. In addition, sediment samples will be collected and analyzed for concentrations of polybrominated flame retardants (i.e., PBDEs), the insecticide Fipronil, and *Clostridium perfringens*, a pathogenic microorganism which is widely distributed in the environment where spores of the organism persist in soil, sediments, and areas subject to human or animal fecal pollution. Water samples also will be collected and analyzed for the triazine herbicide Atrazine, and for additional bacterial and viral indicators of fecal contamination. While these latter suites of sediment and water samples are not standard NS&T measurements, they conform to broader suite of proposed activities presented herein (by all of the partners), and will provide a robust addition to the overall coordinated federal response. Lastly, additional oyster samples will be collected at each of the Mussel Watch sites and provided to FDA's Gulf Coast Seafood Laboratory for the analysis of complementary chemical and microbial indicators of seafood safety, including petroleum hydrocarbon contaminants (through use of FDA's new BTEX technology) and a variety of microbial indicators (e.g., fecal coliforms, bacteriophages, *E. coli*, *enterococci*).

4) FDA Assessment of Seafood Safety

Objectives: Goals include: a) Assist State Health Agencies in the Katrina-affected region by measuring key chemical and microbial indicators of seafood safety in commercially important species (i.e. shellfish, finfish, crab, shrimp); b) Assist State Health Agencies in evaluating data and the implications for seafood.

Summary:

In the aftermath of Hurricane Katrina the Louisiana Dept. of Health and Hospitals (LDHH) has requested that FDA conduct a microbiological and chemical assessment of the fisheries of Lake Pontchartrain and outfall receiving waters of Lake Borgne. The FDA Gulf Coast Seafood Laboratory (GCSL), Dauphin Island, Alabama will deploy in early October two small-boat teams to Lake Pontchartrain/Lake Borgne to collect commercially important seafood species (i.e. shellfish, finfish, crabs, and shrimp) under the guidance of the Louisiana Dept. of Wildlife and Fisheries. Field sampling will be conducted for a period of approximately 6 weeks. Microbiological and chemical analyses will be conducted at the GCSL, at FDA Southeast Regional Laboratory in Atlanta, GA, and other FDA laboratories as appropriate. Microbiological analytes will include fecal coliforms, bacteriophages, and *E. coli*. Chemical analytes will include volatile petrochemical hydrocarbons, polynuclear aromatic hydrocarbons (PAH), pesticides and heavy metals. Results will be forwarded to LDHH. FDA will assist LDHH in the evaluation of analytical data for potential implications for the safety of Louisiana seafood.

Two FDA small-boat teams will be deployed to Louisiana. Team 1 will access 6 sampling sites in Lake Borgne and 2 sites in the northern half of Lake Pontchartrain (figure 5). Team 2 will access the 8 southern sampling sites of Lake Pontchartrain. Samples will be collected under the guidance of the Louisiana Dept. of Wildlife and Fisheries (LDWF). A total of 10 sites will be sampled in Lake Pontchartrain (figure 5). Six (6) sites will be sampled in Lake Borgne and will correspond with pre-positioned LDWF shellfish sampling stations. The Lake Pontchartrain sites will correspond with pre-positioned LA Dept. of Environmental Quality (LDEQ) water quality sampling stations. Five (5) of these stations are located along the southern shore of Lake Pontchartrain and ½ mile offshore of New Orleans. Five (5) additional sites transect the lake along the causeway. LDEQ has collected extensive water quality data for these stations.

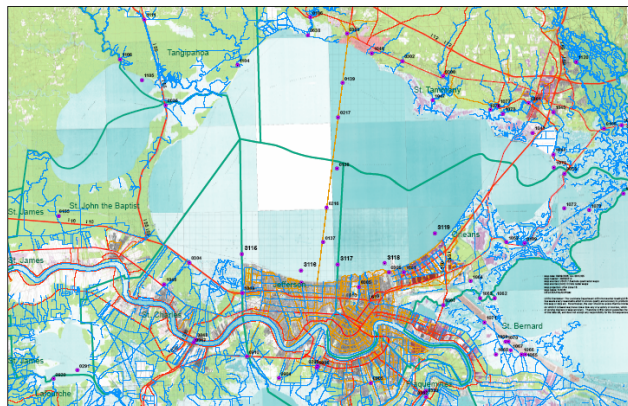


Figure 5

The FDA will coordinate field sampling operations with EPA and NOAA to expand FDA assessments of key indicators of seafood safety to operational areas of the NOAA NS&T program, mussel watch project. This cooperative effort will extend the measurement of key indicators in shellfish from southwest Louisiana to Mobile Bay, Alabama. The combined inter-agency activities outlined here will add a critical component to the larger characterization of Katrina's impacts. FDA and its partners at NOAA, EPA and USGS will continue to coordinate their responses to states affected by Katrina.

5) NOAA Expansion of Mussel Watch

Objectives: In addition to the above collaborations with FDA and the sampling and analysis by NOAA Fisheries, another related goal is to work with the Gulf Coast States and NOAA's Office of Response and Restoration (ORR) to develop and implement an overall cogent strategy for addressing shellfish and other seafood safety issues in the region.

Summary: NCCOS and ORR have recently initiated discussions pertaining to this component. Because key ORR personnel are currently deployed in the affected region, the planning is still underway. A key component of this work, however, will be an expanded NS&T Mussel Watch effort. Because of the extraordinary nature of this natural disaster and associated impacts, NS&T scientists have briefly discussed with its ORR partners a strategy to measure contaminants in the region with increased frequency (quarterly) over an overall three year horizon. If the Program is able to achieve this ambitious post-impact monitoring schedule, it will result in robust estimates of sediment and tissue contamination for the region that can be used to evaluate short-term trends in the context of a well established historical record at these sites. Furthermore, funding permitting, NS&T will sample the benthic

infauna at these locations during the 3-year period to construct a time series documenting changes in the biological community structure in response to contamination and physical-forcing mechanisms. To complement this work, a series of bioassays will be performed to estimate sediment toxicity levels as part of an integrated assessment of the biological effects of contamination that has resulted from the storm. The combined activities outlined here will complement the proposed series of activities planned by EPA and its partners in the waters off LA, MS, and AL, and will add a critical component to the larger characterization of Katrina's impacts.

6) NOAA Assessment of downstream contamination and coastal ecosystem threats

Objectives: To obtain necessary oceanographic field observations, and satellite analyses, to use Gulf of Mexico wide and coastal hydrodynamic models to predict the downstream trajectory, distribution and concentration of dissolved contaminants and toxics (and potential consequences such as HABs).

Summary: Recognizing the model predictions and local observations alone will not suffice to determine the probability of downstream pollutant exposures, OAR and NMFS, in cooperation with the academic community and the State of Florida, have initiated a coordinated field observation, satellite remote-sensing and modeling effort (figure 6). AOML, USF and UM oceanographers are using satellite remote-sensing data (altimetry, color and SST) to make preliminary assessments of the downstream trajectory, distribution and concentration of dissolved contaminants and toxics. September 22-24 the RV/Cape Hatteras deployed satellite-tracked open ocean drifters from AOML's Global Drifter Center from the Dry Tortugas to the northern Gulf of Mexico. The week of September 26 the FV/Patricia Jean deployed the first of four sets of coastal satellite-tracked drifters along the coast of Louisiana and Mississippi. Two cruises are planned for October in which the oceanography and water quality throughout the northern, central and eastern Gulf will be sampled by AOML, NMFS and Florida DEP scientists. Hydrodynamic models incorporating tracer simulations will assimilate the above data and provide rigorous 5-7 day forecasts of downstream exposure over the three month period following the landfall of Katrina. Essential to these efforts will be incorporation of water quality assessments being made in coastal Louisiana and Mississippi by EPA, NOAA and their regional collaborators.

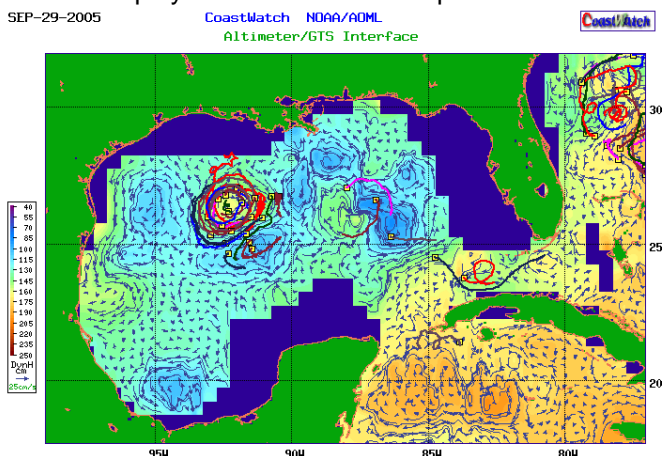


Figure 6

Agency Points of Contact:

1. US Environmental Protection Agency (EPA)

Dr. William H. Benson, Director, EPA Office of Research and Development, Gulf Ecology Division
(850) 934-9208

Benson.William@epa.gov

2. National Oceanic and Atmospheric Administration (NOAA)

Dr. Steve Murawski, Chief Scientist, NOAA Fisheries Service
(301) 713-2239

Steve.Murawski@noaa.gov

3. US Geological Survey (USGS)

Donna Meyers, Chief, National Water Quality Assessment Program
(703) 648-5012

dnmyers@usgs.gov

4. US Food and Drug Administration (FDA)

Dr. Robert Dickey, Chief, Chemical Hazards Research Unit, Gulf Coast Seafood Laboratory
(251) 690-3368

Robert.Dickey@cfsan.fda.gov